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TITLE:

(6)

An investigation of the regions of convergence of the expansions in series of the coordinates of undisturbed motion

PERIODICAL: Astronomicheskiy zhurnal, v.39, 1962, 938-950

TEXT:

The author investigated the expansion of functions of the eccentric anomaly, converging not along the whole trajectory, but only for particular values of the mean anomaly. Two types of such expansions are studied: one in powers of  $(1 - e)$ , where  $e$  is the eccentricity, the other in multiples of the eccentric anomaly. The relation between the eccentric anomaly and the eccentricity is given by the equation

$$E = M + e \sin E, \quad (1)$$

where  $M$  is the mean anomaly, from which may be derived the differential equation

$$\frac{dE}{de} = \frac{\sin E}{1 - e \cos E} \quad (2)$$

Card 1/3

The equations for the curves on which lie the singular points of this equation for both elliptic and hyperbolic motions are obtained. Each curve is the continuation of the other, being a branch of the "particular curve of Keplerian motion", which is the envelope of a one-parameter family of circles whose radii are the radii of convergence of the expansion of the eccentric anomaly for elliptic and hyperbolic motions in powers of  $(e - e_0)$ ; a method of obtaining these radii is described. For values of the eccentricity near to unity the series converge slowly; therefore, the possibility of constructing series in powers of  $(1 - e)$  is considered and critical values of the mean anomaly are obtained as a function of  $e$ , for which the series converge. In order to study motion within this region of convergence, it is necessary to have Fourier series in the case of elliptic motion and Loran series in the case of hyperbolic motion in the eccentric anomaly. The coordinates of a point moving in a Keplerian orbit can be represented by functions of the form

$$\frac{f(e, E)}{(1 - e \cos E)^\alpha} \quad (27)$$

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Introducing  $z = \tan \varphi/2$ , where  $\varphi = \arcsin e$ , the convergence in powers of  $(1 - z)$  of Eq.(27) (or, rather, its equivalent after the introduction of  $z$ ) is studied. The regions of convergence for the expansions in powers of  $(1 - e)$  and  $(1 - z)$  overlap for all  $M$ , except  $M = 0$ , so by combining the two types of series, motion along the whole trajectory can be studied. There are 9 figures and 6 tables.

SUBMITTED: June 28, 1961